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PTO/SB/05 (4/98)
Approved for use through 09/30/2000. OMB 0651-0032
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No.

First Inventor or Application Identifier

Title *apparatus and method for the treatment of
Dyslipidemia using fiber-coupled lasers*

Express Mail Label No.

82195570 4278

FedEx

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☒ * Fee Transmittal Form (e.g., PTO/SB/17) —
(Submit an original and a duplicate for fee processing)

2. ☒ Specification ☒ [Total Pages *9*]
(preferred arrangement set forth below)

- Descriptive title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings (if filed)
- Detailed Description
- Claim(s)
- Abstract of the Disclosure

3. ☒ Drawing(s) (35 U.S.C. 113) ☒ [Total Sheets *3*]

4. Oath or Declaration [Total Pages *1*]

- a. ☒ Newly executed (original or copy)
- b. ☐ Copy from a prior application (37 C.F.R. § 1.63(d))
(for continuation/divisional with Box 16 completed)
- i. ☐ DELETION OF INVENTOR(S)
Signed statement attached deleting
inventor(s) named in the prior application,
see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

* NOTE FOR ITEMS 1 & 3: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY
FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT
IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

5. ☐ Microfiche Computer Program (Appendix)
6. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
- a. ☐ Computer Readable Copy
- b. ☐ Paper Copy (identical to computer copy)
- c. ☐ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. ☐ Assignment Papers (cover sheet & document(s))
8. ☐ 37 C.F.R. § 3.73(b) Statement ☐ Power of
(when there is an assignee) Attorney
9. ☐ English Translation Document (if applicable)
10. ☐ Information Disclosure ☐ Copies of IDS
Statement (IDS)/PTO-1449 Citations
11. ☐ Preliminary Amendment
12. ☐ Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)
13. ☒ * Small Entity ☐ Statement filed in prior application,
Statement(s) Status still proper and desired
(PTO/SB/09-12)
14. ☐ Certified Copy of Priority Document(s)
(if foreign priority is claimed)
15. ☐ Other: _____

16. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No: _____
Prior application information: Examiner _____ Group / Art Unit: _____

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied
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17. CORRESPONDENCE ADDRESS

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or ☒ Correspondence address below

Name

J. T. LIN

Address

4532 Old Carriage Trail

City

Oviedo

State

FL

Zip Code

32765

Country

Telephone

407-482-4555

Fax

407-482-0505

Name (Print/Type)

J. T. LIN

Registration No. (Attorney/Agent)

Signature

[Signature]

Date

Nov. 3, 2000

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<h1 style="margin: 0;">FEE TRANSMITTAL</h1> <h2 style="margin: 0;">for FY 2000</h2> <p style="font-size: small; margin: 5px 0;">Patent fees are subject to annual revision. Small Entity payments must be supported by a small entity statement, otherwise large entity fees must be paid. See Forms PTO/SB/09-12. See 37 C.F.R. §§ 1.27 and 1.28.</p>	<p>Complete if Known</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 60%;">Application Number</td><td></td></tr> <tr><td>Filing Date</td><td></td></tr> <tr><td>First Named Inventor</td><td>J. T. LIN</td></tr> <tr><td>Examiner Name</td><td></td></tr> <tr><td>Group / Art Unit</td><td></td></tr> <tr><td>Attorney Docket No.</td><td></td></tr> </table>	Application Number		Filing Date		First Named Inventor	J. T. LIN	Examiner Name		Group / Art Unit		Attorney Docket No.	
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METHOD OF PAYMENT (check one)	FEE CALCULATION (continued)																																																																																																																								
<p>1. <input type="checkbox"/> The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:</p> <p>Deposit Account Number </p> <p>Deposit Account Name </p> <p><input type="checkbox"/> Charge Any Additional Fee Required Under 37 CFR §§ 1.16 and 1.17</p> <p>2. <input checked="" type="checkbox"/> Payment Enclosed:</p> <p style="margin-left: 20px;"> <input checked="" type="checkbox"/> Check <input type="checkbox"/> Money Order <input type="checkbox"/> Other </p>	<p>3. ADDITIONAL FEES</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Large Entity Fee Code</th> <th>Small Entity Fee Code</th> <th>Fee Description</th> <th>Fee Paid</th> </tr> </thead> <tbody> <tr><td>105 130</td><td>205 65</td><td>Surcharge - late filing fee or oath</td><td></td></tr> <tr><td>127 50</td><td>227 25</td><td>Surcharge - late provisional filing fee or cover sheet</td><td></td></tr> <tr><td>139 130</td><td>139 130</td><td>Non-English specification</td><td></td></tr> <tr><td>147 2,520</td><td>147 2,520</td><td>For filing a request for reexamination</td><td></td></tr> <tr><td>112 920*</td><td>112 920*</td><td>Requesting publication of SIR prior to Examiner action</td><td></td></tr> <tr><td>113 1,840*</td><td>113 1,840*</td><td>Requesting publication of SIR after Examiner action</td><td></td></tr> <tr><td>115 110</td><td>215 55</td><td>Extension for reply within first month</td><td></td></tr> <tr><td>116 380</td><td>216 190</td><td>Extension for reply within second month</td><td></td></tr> <tr><td>117 870</td><td>217 435</td><td>Extension for reply within third month</td><td></td></tr> <tr><td>118 1,360</td><td>218 680</td><td>Extension for reply within fourth month</td><td></td></tr> <tr><td>128 1,850</td><td>228 925</td><td>Extension for reply within fifth month</td><td></td></tr> <tr><td>119 300</td><td>219 150</td><td>Notice of Appeal</td><td></td></tr> <tr><td>120 300</td><td>220 150</td><td>Filing a brief in support of an appeal</td><td></td></tr> <tr><td>121 260</td><td>221 130</td><td>Request for oral hearing</td><td></td></tr> <tr><td>138 1,510</td><td>138 1,510</td><td>Petition to institute a public use proceeding</td><td></td></tr> <tr><td>140 110</td><td>240 55</td><td>Petition to revive - unavoidable</td><td></td></tr> <tr><td>141 1,210</td><td>241 605</td><td>Petition to revive - unintentional</td><td></td></tr> <tr><td>142 1,210</td><td>242 605</td><td>Utility issue fee (or reissue)</td><td></td></tr> <tr><td>143 430</td><td>243 215</td><td>Design issue fee</td><td></td></tr> <tr><td>144 580</td><td>244 290</td><td>Plant issue fee</td><td></td></tr> <tr><td>122 130</td><td>122 130</td><td>Petitions to the Commissioner</td><td></td></tr> <tr><td>123 50</td><td>123 50</td><td>Petitions related to provisional applications</td><td></td></tr> <tr><td>126 240</td><td>126 240</td><td>Submission of Information Disclosure Stmt</td><td></td></tr> <tr><td>581 40</td><td>581 40</td><td>Recording each patent assignment per property (times number of properties)</td><td></td></tr> <tr><td>146 690</td><td>246 345</td><td>Filing a submission after final rejection (37 CFR § 1.129(a))</td><td></td></tr> <tr><td>149 690</td><td>249 345</td><td>For each additional invention to be examined (37 CFR § 1.129(b))</td><td></td></tr> <tr><td colspan="3">Other fee (specify) _____</td><td></td></tr> <tr><td colspan="3">Other fee (specify) _____</td><td></td></tr> <tr> <td colspan="2" style="text-align: right;">Reduced by Basic Filing Fee Paid</td> <td>SUBTOTAL (3) (\$)</td> <td></td> </tr> </tbody> </table>	Large Entity Fee Code	Small Entity Fee Code	Fee Description	Fee Paid	105 130	205 65	Surcharge - late filing fee or oath		127 50	227 25	Surcharge - late provisional filing fee or cover sheet		139 130	139 130	Non-English specification		147 2,520	147 2,520	For filing a request for reexamination		112 920*	112 920*	Requesting publication of SIR prior to Examiner action		113 1,840*	113 1,840*	Requesting publication of SIR after Examiner action		115 110	215 55	Extension for reply within first month		116 380	216 190	Extension for reply within second month		117 870	217 435	Extension for reply within third month		118 1,360	218 680	Extension for reply within fourth month		128 1,850	228 925	Extension for reply within fifth month		119 300	219 150	Notice of Appeal		120 300	220 150	Filing a brief in support of an appeal		121 260	221 130	Request for oral hearing		138 1,510	138 1,510	Petition to institute a public use proceeding		140 110	240 55	Petition to revive - unavoidable		141 1,210	241 605	Petition to revive - unintentional		142 1,210	242 605	Utility issue fee (or reissue)		143 430	243 215	Design issue fee		144 580	244 290	Plant issue fee		122 130	122 130	Petitions to the Commissioner		123 50	123 50	Petitions related to provisional applications		126 240	126 240	Submission of Information Disclosure Stmt		581 40	581 40	Recording each patent assignment per property (times number of properties)		146 690	246 345	Filing a submission after final rejection (37 CFR § 1.129(a))		149 690	249 345	For each additional invention to be examined (37 CFR § 1.129(b))		Other fee (specify) _____				Other fee (specify) _____				Reduced by Basic Filing Fee Paid		SUBTOTAL (3) (\$)	
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SUBMITTED BY		Complete (if applicable)	
Name (Print/Type)	J. T. LIN	Registration No. (Attorney/Agent)	
Signature		Telephone	407-482-4555
		Date	NOV. 3, 2000

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**STATEMENT CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) & 1.27(b))—INDEPENDENT INVENTOR**

Docket Number (Optional)

Applicant, Patentee, or Identifier: J. T. LIN

Application or Patent No.: _____

Filed or Issued: _____

Title: Apparatus & methods for the Treatment of
Myopia using fiber-coupled Lasers

As a below named inventor, I hereby state that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees to the Patent and Trademark Office described in:

- ☒ the specification filed herewith with title as listed above.
☐ the application identified above.
☐ the patent identified above.

I have not assigned, granted, conveyed, or licensed, and am under no obligation under contract or law to assign, grant, convey, or license, any rights in the invention to any person who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

- ☒ No such person, concern, or organization exists.
☐ Each such person, concern, or organization is listed below.

Separate statements are required from each named person, concern, or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

J. T. LIN
NAME OF INVENTOR

[Signature]
Signature of inventor

Nov. 3, 2000
Date

NAME OF INVENTOR

Signature of inventor

Date

NAME OF INVENTOR

Signature of inventor

Date

APPARATUS AND METHODS FOR THE TREATMENT OF PRESBYOPIA USING FIBER-COUPLED-LASERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to methods and apparatus for the treatment of presbyopia using fiber-coupled lasers to ablate the sclera tissue.

2. Prior Art

Corneal reshaping including a procedure called photorefractive keratectomy (PRK) and a new procedure called laser assisted in situ keratomileusis, or laser intrastroma keratomileusis (LASIK) have been performed by lasers in the ultraviolet (UV) wavelength of (193 - 213) nm. The commercial UV refractive lasers include ArF excimer laser (at 193 nm) and other non-excimer, solid-state lasers such as those proposed by the present inventor in 1992 (US pat. no. 5,144,630) and in 1996 (US pat. No. 5,520,679). The above-described prior arts using lasers to reshape the corneal surface curvature, however, are limited to the corrections of myopia, hyperopia and astigmatism..

Refractive surgery using a scanning device and lasers in the mid-infrared (mid-IR) wavelength was first proposed by the present inventor in US Pat. No. 5,144,630 and 5,520,679 and later proposed by Telfair et. al., in US Pat. No. 5,782,822, where the generation of mid-IR wavelength of (2.5-3.2) microns were disclosed by various methods including: the Er:YAG laser (at 2.94 microns), the Raman-shifted solid state lasers (at 2.7-3.2 microns) and the optical parametric oscillation (OPO) lasers (at 2.7-3.2 microns).

Corneal reshaping may also be performed by laser thermal coagulation currently conducted by a Ho:YAG laser (at about 2 microns in wavelength) proposed by Sand in US Pat. 5,484,432. This method, however, was limited to low-diopter hyperopic corrections. Strictly speaking this prior art did not correction the true "presbyopia" and only performed the mono-vision for hyperopic patients. A thermal laser is required and the laser treated area was within the optical zone diameters of about 7 mm.

Ruiz in US pat. No. 5,533,997 proposed the use of laser ablation of cornea surface to correct presbyopic patients. This prior art, however, must generate multifocal (or bifocal) surface on the central portion of the cornea in order to achieve the desired presbyopia correction. Corneal curvature change by laser ablation in this prior art, however, did not

1 actually resolve the intrinsic problems of presbyopic patient caused by age where the cornea
2 lens loss its accommodation as a result of loss of elasticity due to age.

3 All the above-described prior arts are using methods to change the cornea surface
4 curvature either by tissue ablation (such as in UV laser) or by thermal shrinkage (such as in
5 Ho:YAG laser) and all are using lasers onto the central portion of the cornea.

6 The alternative method for presbyopia correction, therefore, is to increase the
7 accommodation of the presbyopic patients by change the intrinsic properties of the sclera and
8 ciliary tissue to increase the lens accommodation without changing the cornea curvature. This
9 method of sclera ablation is fundamentally different from all the prior arts including that of
10 Ruiz, in which reshaping cornea curvature into multifocal shape was required for presbyopia
11 correction.

12 Correction of presbyopia via the expanding of the sclera by mechanical devices was
13 recently proposed by Schachar in US patents 5,489,299 and 5,354,331. These prior arts all
14 require the implant of external band or using laser heating to affect the position of the
15 insertion band and have the drawbacks of complexity, time consuming, costly and potential
16 for side effects. To treat presbyopia, Schachar's other US patents 5,529,076 and 5,722,952,
17 proposed the use of heat or radiation on the corneal epithelium to arrest the growth of the
18 crystalline lens by laser coagulation effects. However these two prior arts did not present any
19 details or practical methods and there was no clinical studies have been practiced to show the
20 effectiveness of the proposed concepts.

21 Roberto Albertazzi et al (Ocular Surgery News, July, 1999) recently proposed to use
22 diamond knife for the incision of the sclera tissue outside the limbus rings to increase the
23 space for sclera expansion. This method however caused corneal bleeding and regression is
24 frequently found after the treatments. We note that there is intrinsic difference between a laser
25 ablation proposed in this invention and the knife incision. The sclera space produced by the
26 incision method is not permanent and may be greatly reduced during the tissue healing and
27 cause the regression. This major source of regression in incision method however will not
28 occur in the laser ablation method as proposed in this invention, where portion of the sclera
29 tissue is permanently removed.

30 The "presbyopia" correction proposed by Ruitz (US Pat. No. 5,533,997) using an
31 excimer (ArF) laser also required the corneal surface to be reshaped to form "multifocal"
32 effort for a presbyopia patients to see near and far. However, Ruitz's "presbyopia" correction is
33 fundamentally different from that of the present patent which does not change the corneal
34 curvature. The presbyopia correction proposed in the present patent is to increase patient's

1 accommodation rather than reshaping the cornea into "multifocal" surface.

2 The technique used in the prior art of Bille (Pat. No. 4,907,586) required a quasi-
3 continuous laser having pulse duration less than 10 picoseconds and focused spot less than 10
4 micron diameter and the laser is confined to the interior of a selected tissue to correct myopia,
5 hyperopia or astigmatism. Bille also proposed the laser to focused into the lens of an eye to
6 prevent presbyopia. This prior art system is very complicate and needs a precise control of the
7 laser beam size and focusing position. Furthermore, clinical risk of cataract may occur when
8 laser is applied into the lens area.

9 Treatment of presbyopia by cold lasers was recently proposed by the present inventor in
10 US Pat. Application Nos. 09/189,609 and 09/391,503. These pending patents, however,
11 require the use of a scanning device to generate the laser ablation patterns on the cornea.
12 These systems therefore involve with complicated hardware and software for scanning
13 patterns and patient centration or eye movement is critical.

14 Accordingly, there is a strong need to treat presbyopia via laser ablation of the sclera
15 tissue using a laser system which may be delivered by a hand held fiber unit. Furthermore,
16 the system may be used in either non-contact or contact modes with laser beam spot sizes
17 defined by the size and shapes of the fiber tips. System proposed in the present patent will be
18 safer than that of prior arts because the central portion of the cornea remains intact and only
19 the area outside the limbus will be ablated by the laser. It is yet another objective of the
20 present patent is to provide a no-invasive method where the conjunctiva layer may be lifted to
21 generate the "gap" for fiber tip to insert into the gap and ablate the desired patterns underneath
22 and to avoid or minimize bleeding or infection.

23 24 SUMMARY OF THE INVENTION

25 The preferred embodiments of the basic surgical lasers of the present
26 invention shall include: (a) infrared (IR) lasers having wavelengths range of about (1.4 – 3.2)
27 microns including but not limited to solid state lasers of Er:glass, Ho:YAG, Er:YAG,
28 Er:YSGG, infrared gas lasers, solid-state lasers converted by optical parametric oscillation
29 (OPO); (b) ultraviolet (UV) lasers having wavelength range of about (190 – 355) nm, such as
30 ArF (at 193 nm) and XeCl (at 308 nm) excimer lasers and solid-state lasers using frequency
31 conversions; (c) semiconductor diode lasers at about 980 nm, (1.3-1.55) microns, and (1.8-
32 2.1) microns; (d) diode-pumped solid state lasers having wavelength range of about (190-355)
33 nm and (2.7-3.2) microns such as diode-pumped Er:YSGG, Er:YAG, Nd:YAG, Er:glass and
34 Ti:sapphire laser and their harmonic generation.

1 It is yet another preferred embodiment is to couple the basic lasers by a fiber
2 and deliver the laser beam to the treated area of the eye by a handheld piece which is further
3 connected to a fiber-tip at various shapes.

4 It is yet another preferred embodiment to focus the laser beams into a desired
5 spot size on the treated area of the eye. Various ablation patterns may be generated manually
6 via the fiber-connected hand piece including multiple rings of spots and radial line incisions
7 outside the limbus.

8 It is yet another preferred embodiment is to open the conjunctiva layer prior to
9 the laser ablation of the under-layer of the sclera tissue for a better control of the ablation
10 depth and for safety reasons. It is yet another preferred embodiment is that the conjunctiva
11 layer may be lifted to generate the "gap" for fiber tip to insert into the gap and ablate the
12 desired patterns underneath and to avoid or minimize bleeding or infection.

13 Further preferred embodiments of the present invention will become apparent
14 from the description of the invention which follows.

15 16 **BRIEF DESCRIPTION OF THE DRAWINGS**

17 FIG. 1 is a block diagram of the integrated laser system consisting of a laser, a
18 coupling fiber delivery unit and a hand-piece connected to a fiber-tip to control the beam spot
19 on the treated area.

20 FIG. 2 shows various shapes of the fiber tips: (A) flat tip, (B) spherical tip for focused
21 contact use, (C) conical tip, (D) 90-degree angle tip, and (E) focused slit-spot.

22 FIG. 3 shows various ablation patterns generated by the ablating laser outside the
23 limbus.

24 25 **DETAILED DESCRIPTION OF THE INVENTION AND THE** 26 **PREFERRED EMBODIMENTS** 27

28 Referring to Fig. 1, a surgical laser system in accordance with the present invention
29 comprises a basic laser 1 having wavelength 2 coupled by a focusing lens 3 to a fiber 4 which
30 is connected to a hand-piece 5 and a fiber tip 6. The focusing lens 3, fiber 4 and fiber tip 6 are
31 highly transparent to the wavelength 2 of the basic laser.

32 Still referring to Fig. 1, according to the present invention, the preferred
33 embodiments of the basic surgical lasers for presbyopia correction procedures shall include:
34 (a) infrared lasers having wavelengths range of about (1.4 – 3.2) microns including but not

1 limited to solid state lasers of Er:glass, Ho:YAG, Er:YAG, Er:YSGG, infrared gas lasers,
2 solid-state lasers converted by optical parametric oscillation (OPO); (b) ultraviolet (UV)
3 lasers having wavelength range of about (190 – 355) nm, such as ArF (at 193 nm) and XeCl
4 (at 308 nm) excimer lasers and solid-state lasers using harmonic generation from solid-state
5 lasers of Nd:YAG, Nd:YLF and Alexandrite lasers frequency conversions; (c) semiconductor
6 diode lasers at about 980 nm, (1.3-1.55) microns, and (1.8-2.1) microns; (d) diode-pumped
7 solid state lasers having wavelength range of about (190-355) nm and (2.7-3.2) microns such
8 as diode-pumped Er:YSGG, Er:YAG, Nd:YAG and Er:glass. and; (e) diode lasers having
9 wavelength at about 980 nm, 1.5 microns, and 1.9 microns.

10 According to one aspect of the present invention, the preferable scanning laser energy per
11 pulse on corneal surface is about (2-20) mJ in IR lasers and about (0.5 – 2.0) mJ in UV lasers.
12 Focused spot size of about (0.1-0.5) mm in diameter on the corneal plane is achieved by the
13 focusing lens 3 which consists of at least one spherical lens. The other preferred laser
14 parameter of this invention is the laser repetition rate range of about (5-100) Hz which will
15 provide reasonable surgical speed and minimum thermal effects. The focused beam may be
16 scanned over the corneal surface to ablate various patterns to achieve the desired sclera
17 expansion.

18 Referring to Fig. 2(A), the laser output from the fiber end having wavelength 2 is
19 connected to the hand-piece 5 and a flat fiber tip 6 such that the output laser beam from the
20 end of the fiber tip is a round-beam with a pre-determined spot size of about (0.1-0.5) mm.
21 Fig. 2(B) shows similar structure to Fig. 2(A), except the output round-spot beam is re-
22 focused by the spherical shape of the tip. Fig. 3 (C) shows the output beam 2 is guided by a
23 conical shape tip such that the beam size at the end of the tip is reduced. Fig. 2(D) shows that
24 the output beam is reflected by 90-degree by a coated fiber tip. Finally Fig. 2(E) shows an
25 output beam spot is a slit-shape having a size of about (0.1-0.5) x (1.5-3.0) mm formed by a
26 cylinder lens attached to the end of the fiber tip.

27 Fig. 3 shows an eye 7 of a presbyopic patient with ablation patterns 9 generated on the
28 scleral area about (0.5-1.0) mm posterior to the corneal limbus 8. The preferred patterns of
29 this invention include a ring-spot having at least one ring with at least 3 spots in each ring,
30 and a radial-pattern having at least 3 radials. The preferred area of the ablation is defined
31 within two circles having diameters about 10 mm and 14 mm posterior to the limbus along
32 the radial direction of the cornea. We should note that a radial ablation pattern on the corneal
33 surface may be generated either by an automatic scanning device or by manually scan the
34 fiber tip by a surgeon who hold the hand piece. For the situation of the slit fiber-tip, the

1 surgeon may easily generate the radial patterns without moving the tip.

2 The ablation depth of the sclera ciliary tissue is about (400-700) microns with each of the
3 radial length of about (2.5 - 4.0) mm adjustable according to the optimal clinical outcomes
4 including minimum regression and maximum accommodation for the presbyopic patients.
5 The preferred radial ablation shall start at a distance about (4.0 – 5.5) mm from the corneal
6 center and extended about (2.0-4.0) mm outside the limbus. The preferred embodiments of the
7 radial patterns on the sclera area include at least 3 radial lines or ring-dots in a symmetric
8 geometry as shown in Fig. 3.

9 Still referring to Fig. 3, the preferred embodiments to generate the radial patterns on the
10 sclera area include the following examples. (A) Scan the round laser spot of about (0.2- 0.5)
11 mm in diameter produced from the fiber tips in the radial directions to generate each of the
12 radial lines. Generation of the radial patterns may be done either manually moving the fiber
13 tip along the cornea radial direction or by an automatically a scanner or translator. (B) Use a
14 focused slit-beam to generate the radial lines. In case (B), a scanning device is not needed and
15 each of the radial lines may be generated by the slit beam directly.

16 One preferred embodiment is to coagulate the conjunctiva layer and then cut (by a knife)
17 a half-circle over the conjunctiva surrounding the limbus with a diameter about 10 mm which
18 is then pushed aside in order for the ablating laser to cut the sclera layer underneath. It is also
19 possible to use the ablating laser to cut the conjunctiva layer which however may take a
20 longer time than cutting by a knife. Another preferred embodiment is not to open the
21 conjunctiva layer, but to insert the fiber tip through the conjunctiva layer and ablate the sclera
22 tissue underneath such that the procedure is done non-invasively. To do this procedure, the
23 conjunctiva layer may be lifted to generate the “gap” for fiber tip to insert into the gap and
24 ablate the desired patterns underneath. Additional advantages of this invasive method is to
25 avoid or minimize bleeding or infection. We note that most of the bleeding is due to cutting of
26 the conjunctiva tissue rather than the laser ablation of the sclera tissue.

27 While the invention has been shown and described with reference to the preferred
28 embodiments thereof, it will be understood by those skilled in the art that the foregoing and
29 other changes and variations in form and detail may be made therein without departing from
30 the spirit, scope and teaching of the invention. Accordingly, threshold and apparatus, the
31 ophthalmic applications herein disclosed are to be considered merely as illustrative and the
32 invention is to be limited only as set forth in the claims.

CLAIMS:

I claim:

1. A system, adaptable for performing presbyopic correction in which a portion of the corneal sclera tissue is removed by steps of:

(a) selecting a laser beam having a predetermined wavelength;

(b) selecting a beam spot controller mechanism, said beam spot controller to reduce and focus said laser beam to a fiber delivery unit;

(c) controlling the said fiber delivery unit to deliver said laser beam in a said predetermined pattern onto a plurality of positions on the corneal surface to remove portion of the sclera tissue outside the limbus area, whereby a presbyopic patient's vision is corrected to see near and far by increasing the accommodation of the lens.

2. A system as claimed in claim 1, wherein said laser beam is an ultraviolet laser having a wavelength range of about (0.15 - 0.36) microns and a pulse duration less than about 200 nanoseconds.

3. A system as claimed in claim 1, wherein said laser beam is an infrared laser having a wavelength range of about (1.4 - 3.2) microns.

4. A system as claimed in claim 2, wherein infrared laser is an optically pumped Erbium:YAG laser having a wavelength of about 2.9 microns.

5. A system as claimed in claim 1, wherein said laser beam is an ArF excimer laser having a wavelength of 193 nm.

6. A system as claimed in claim 1, wherein said laser beam is a XeCl excimer laser having a wavelength of 308 nm.

7. A system as claimed in claim 1, wherein said laser beam is a solid state diode laser having a wavelength range of about (0.95 - 2.1) microns.

8. A system as claimed in claim 1, in which said beam spot controller consists of at least one focusing spherical lens to couple the said laser beam to the said fiber delivery unit.

9. A system as claimed in claim 1, wherein said fiber delivery unit consists of an optical fiber having a length of about (0.5 - 1.5) meter and core diameter of about (0.2 - 0.8) mm and a hand piece connected to a fiber tip.

1 10. The apparatus of claim 9, wherein said fiber delivery unit is substantially
2 transparent to the wavelength of the said laser beam.

3 11. The apparatus of claim 9, wherein said fiber tip is made of a similar material as
4 that of the fiber and is made in one of the following shapes to focus the said laser beam onto
5 the treated sclera area of the eye: conical, spherical, 90-degree reflecting angle and flat end.

6 12. The apparatus of claim 9, wherein said fiber tip focuses the said laser beam onto
7 the treated area of the eye at a spot size of about (0.1 - 0.5) mm in diameter.

8 13. The apparatus of claim 9, wherein said fiber tip is made in a cylinder shape to
9 focus the said laser beam onto the treated area of the eye at a line shape having a dimension of
10 about (0.1 - 0.4) in width and (0.5 - 4.0) mm in length.

11 14. The apparatus of claim 9, wherein said fiber tip is operated in a contact-mode to
12 ablate the sclera tissue to a depth of about (300 - 800) microns.

13 15. The apparatus of claim 9, wherein said fiber tip is operated in a non-contact mode
14 to ablate the sclera tissue to a depth of about (300 - 800) microns.

15 16. The apparatus of claim 1, wherein said fiber delivery unit is controlled by the
16 surgeon to perform a predetermined patterns outside the limbus of the cornea by manually
17 moving the fiber tip in the radial direction of the cornea.

18 17. A system as claimed in claim 1, wherein said fiber delivery unit is attached to a
19 scanning device to perform said predetermined patterns outside the limbus of the cornea and
20 scan said laser beam along the radial direction of the cornea.

21 18. A system as claimed in claim 1, wherein said predetermined patterns outside the
22 limbus of the cornea defined by the area between two circles having radius of about 5.0 mm
23 and 9.0 mm, respectively.

24 19. A system as claimed in claim 1, wherein said predetermined pattern includes at
25 least 3 radial lines around the area outside the corneal limbus.

26 20. A system as claimed in claim 1, wherein said predetermined pattern includes at
27 least two rings formed by 8 circular spots having a diameter of about (0.2 - 0.5) mm around
28 the area outside the corneal limbus.

29 21. A system as claimed in claim 1, wherein said sclera tissue is removed by said
30 laser beam after the cornea conjunctiva is open.

31 22. A system as claimed in claim 1, wherein said sclera tissue is removed by said
32 laser beam without opening the cornea conjunctiva.

ABSTRACT

Systems and surgical techniques for presbyopia correction by laser removal of the sclera tissue are disclosed. The disclosed preferred embodiments of the system consists of a beam spot controller, a fiber delivery unit and a fiber tip. The basic laser including UV lasers and infrared lasers having wavelength ranges of (0.15-0.36) microns and (1.9-3.2) microns and diode lasers of about 0.98, 1.5 and 1.9 microns. Presbyopia is treated by a system which uses an ablative laser to ablate the sclera tissue outside the limbus to increase the accommodation of the ciliary body of the eye. The sclera tissue may be ablated by the laser with or without the conjunctiva layer open.

J. H. Lin
FIG. 1

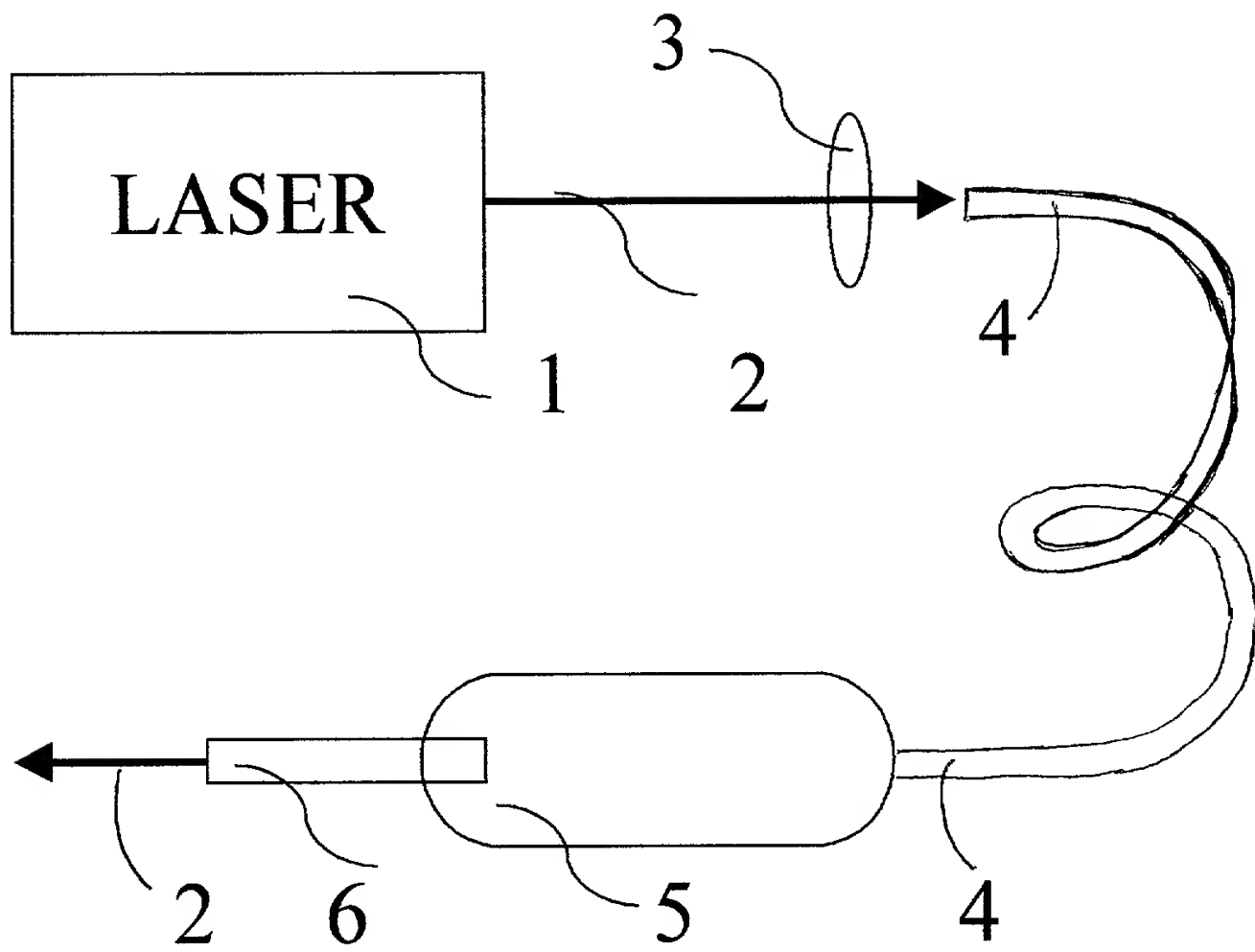


FIG. 1

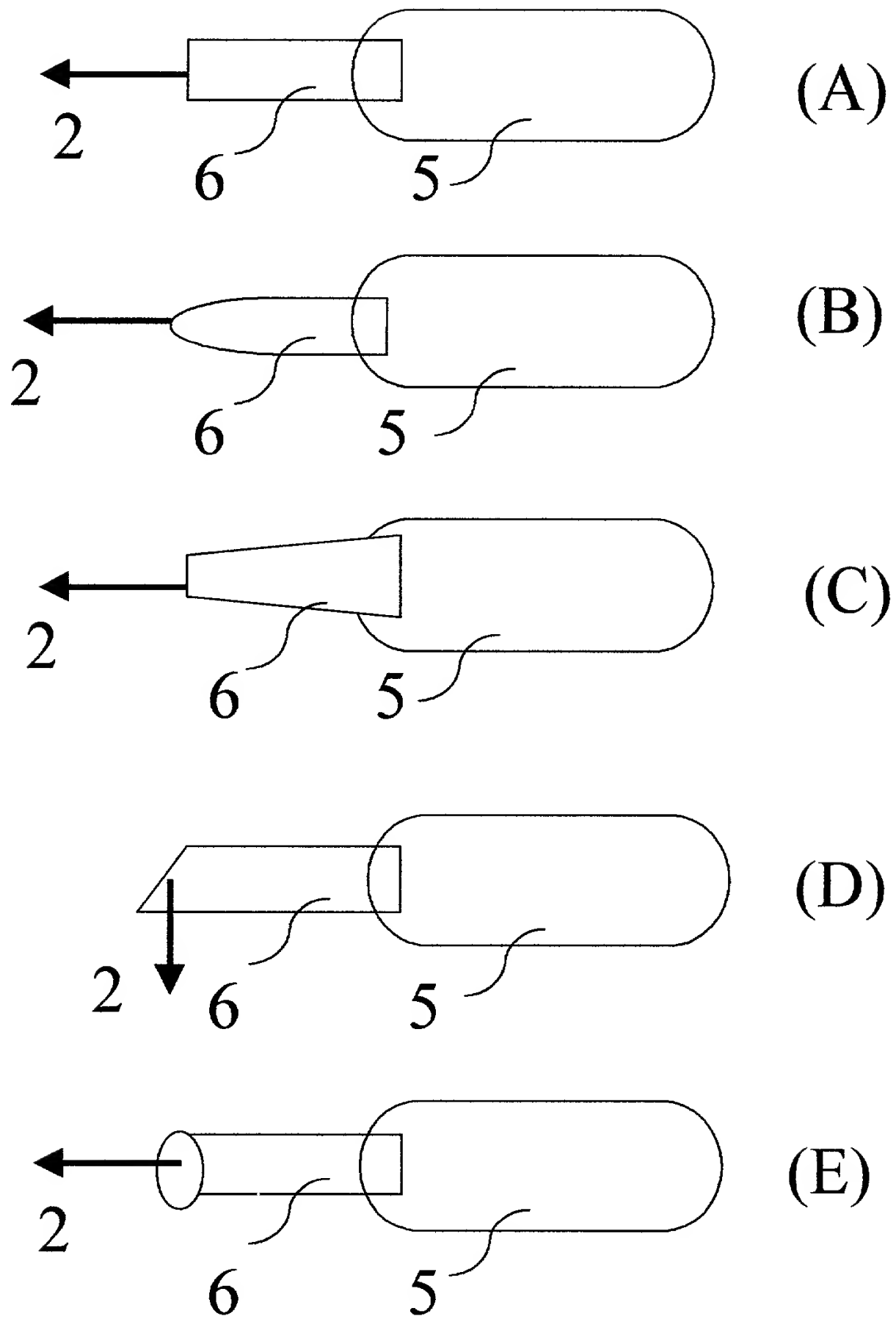
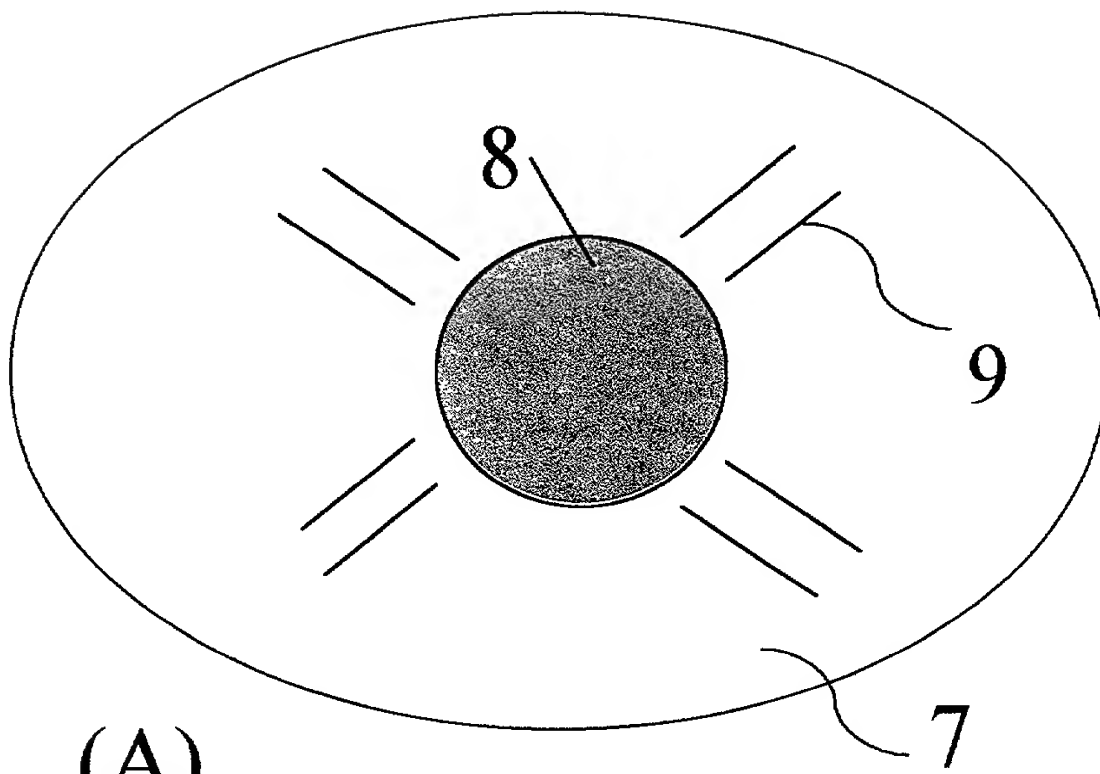
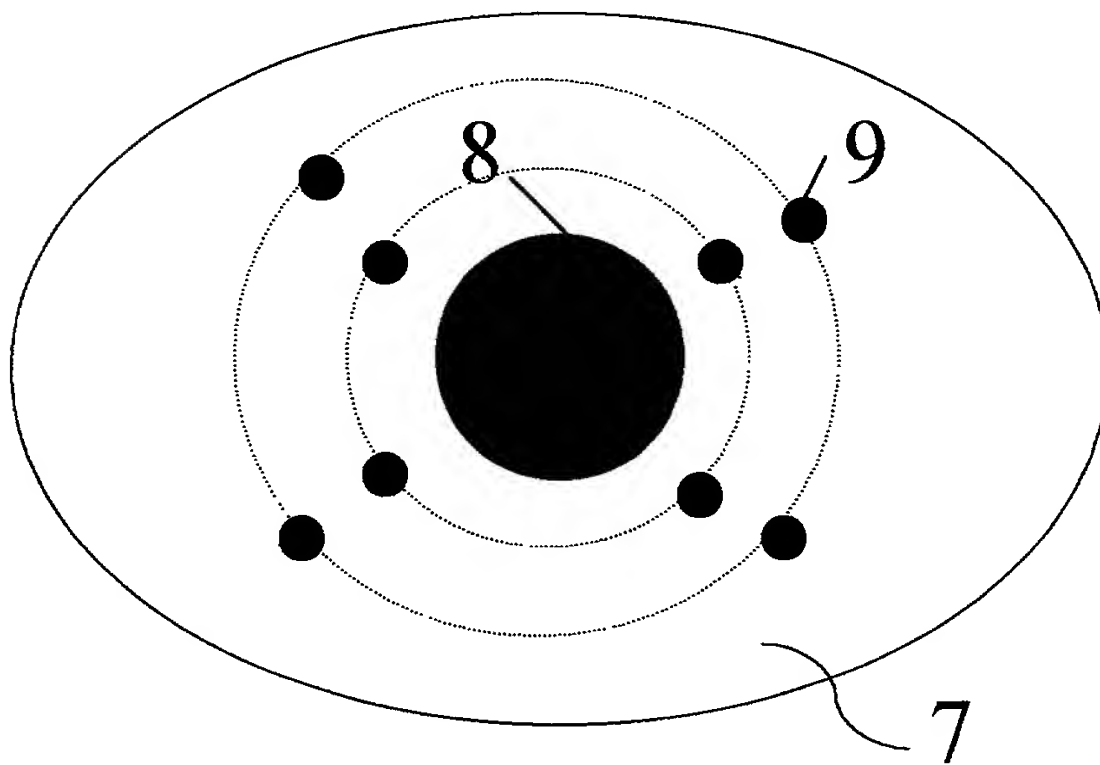


FIG. 2




(A)



(B)

FIG. 3

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Attorney Docket Number

First Named Inventor

J. T. KIN

COMPLETE IF KNOWN

Application Number

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*Apparatus & method for the Treatment of Presbyopia
using fiber coupled-lasers.*

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Name	J. T. LIN				
Address	4532 Old Carriage Trail				
Address					
City	Oviedo	State	FL	ZIP	32765
Country		Telephone	407-482-4555	Fax	407-482-0505

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J. T.		LIN	
Inventor's Signature			Date
Residence: City	Oviedo	State	FL
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		Citizenship	USA
Post Office Address	4532 Old Carriage Trail		
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